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# The Incidence of Psychiatric Disorders Meeting DSM IV Criteria as a Result of a TBI in the General Population with a Specific Focus on New Onset of Depression and Anxiety

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# The Incidence of Psychiatric Disorders Meeting DSM IV Criteria as a Result of a TBI in the General Population with a Specific Focus on New Onset of Depression and Anxiety

## **Abstract**

**Background:** In recent years there has been debate among the medical community in looking to correlate traumatic brain injuries (TBIs) with the onset of psychiatric disorders. Some patients who have sustained TBIs (whether mild, moderate, or severe) appear to suffer long-term health effects whether mental or physical. Patients deal with challenges everyday as a result of their TBIs and thus it is important to address these issues early post-injury. In doing so, it will allow patients to have better access to treatment options initially after their injury, with the hope that they will not suffer long-term consequences. Two of the biggest challenges facing patients are depression and anxiety, especially in the first year after sustaining a TBI. With cases such as these, it is vital to understand that early intervention for novel psychiatric disorders post-TBI, is imperative in reducing long term consequences.

**Method:** An exhaustive search of medical literature was conducted using Medline-Ovid, CINAHL, Web of Science, Medline-PubMed, and Up to Date using the key words: brain injuries, mental disorders, diagnostic and statistical manual of mental disorders, and DSM. The reference lists and bibliographies of the articles were further searched looking for other relevant studies. Relevant articles were then assessed for quality using GRADE.

**Results:** Seven studies met inclusion criteria and were included in this systematic review. Five of the studies were prospective and two of the studies were retrospective. All seven of the studies looked to correlate novel psychiatric disorders as a result of patients sustaining a TBI specifically in the first year post-injury. The studies showed a direct correlation of novel psychiatric disorders as a result of a TBI, with the two most prevalent disorders being depression and/or anxiety.

**Conclusion:** Patients who sustain a TBI, regardless of severity, are at a higher risk of developing a psychiatric disorder within the first year post-injury than those who have not. In the studies reviewed, depression and/or anxiety were the two most common novel disorders after sustaining a TBI. It is important to recognize that patients with brain injuries are at higher risk for psychiatric disorders in order to place an emphasis on earlier screening measures and interventions immediately post-injury.

**Keywords:** brain injuries, mental disorders, diagnostic and statistical manual of mental disorders, DSM

## **Degree Type**

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## **Degree Name**

Master of Science in Physician Assistant Studies

## **First Advisor**

Professor Sommers

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**Keywords**

depression, anxiety, psychiatric, traumatic brain injury

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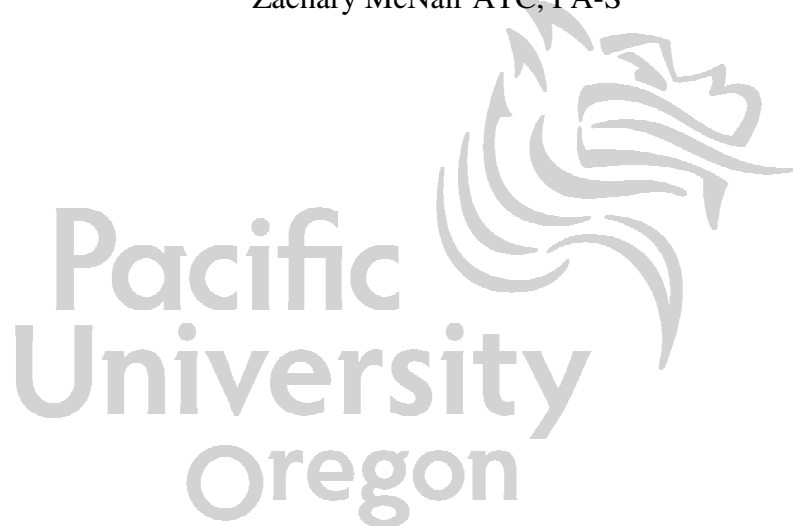
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**The Incidence of Psychiatric Disorders Meeting DSM IV Criteria as a  
Result of a TBI in the General Population with a Specific Focus on New Onset  
of Depression and Anxiety**

Zachary McNair ATC, PA-S



A Clinical Graduate Project Submitted to the Faculty of the

School of Physician Assistant Studies

Pacific University

Hillsboro, OR

For the Masters of Science Degree, August 10, 2013

Faculty Advisor: Annjanette Sommers, PA-C, MS

Clinical Graduate Project Coordinator: Annjanette Sommers, PA-C, MS

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## Biography

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Zachary McNair grew up in Richland, WA. He attended the University of Idaho and graduated with a B.S. in athletic training and sport science in 2008. Zach worked in Phoenix, AZ for two years as head athletic trainer at Paradise Valley High School prior to applying for PA school. With his background in sports medicine and his love for anything joint, muscle, or bone related he hopes to pursue a career as an orthopedic physician assistant.

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# Abstract

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**Background:** In recent years there has been debate among the medical community in looking to correlate traumatic brain injuries (TBIs) with the onset of psychiatric disorders. Some patients who have sustained TBIs (whether mild, moderate, or severe) appear to suffer long-term health effects whether mental or physical. Patients deal with challenges everyday as a result of their TBIs and thus it is important to address these issues early post-injury. In doing so, it will allow patients to have better access to treatment options initially after their injury, with the hope that they will not suffer long-term consequences. Two of the biggest challenges facing patients are depression and anxiety, especially in the first year after sustaining a TBI. With cases such as these, it is vital to understand that early intervention for novel psychiatric disorders post-TBI, is imperative in reducing long term consequences.

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**Results:** Seven studies met inclusion criteria and were included in this systematic review. Five of the studies were prospective and two of the studies were retrospective. All seven of the studies looked to correlate novel psychiatric disorders as a result of patients sustaining a TBI specifically in the first year post-injury. The studies showed a direct correlation of novel psychiatric disorders as a result of a TBI, with the two most prevalent disorders being depression and/or anxiety.

**Conclusion:** Patients who sustain a TBI, regardless of severity, are at a higher risk of developing a psychiatric disorder within the first year post-injury than those who have not. In the studies reviewed, depression and/or anxiety were the two most common novel disorders after sustaining a TBI. It is important to recognize that patients with brain injuries are at higher risk for psychiatric disorders in order to place an emphasis on earlier screening measures and interventions immediately post-injury.

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## Abbreviations

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TBI	Traumatic Brain Injury
GCS	Glasgow Coma Scale
LOC	Loss of Consciousness
PTSD	Post traumatic stress disorder
SCID	Structured Interview for Clinical Disorders
MVA	Motor Vehicle Accident
MDD	Major depressive disorder
CNS	Central nervous system
CHI	Closed head injury
GAD	Generalized anxiety disorder
HA	Headache

# **The Incidence of Psychiatric Disorders Meeting DSM IV Criteria as a Result of a TBI in the General Population with a Specific Focus on New Onset of Depression and Anxiety**

## **BACKGROUND**

Traumatic brain injuries (TBIs) continue to play a significant role in long term disability and death in the general population. The disabilities people face from suffering a TBI may be physical, mental, or a combination of both. Many suspect a direct relationship between patients who have sustained a TBI and the development of new psychiatric disorders, mainly depression.<sup>1-2</sup> There has also been significant emphasis placed on patients with a pre-injury psychiatric disorder which may put this population at higher risk to sustain a TBI.<sup>3</sup> Regardless of pre-injury diagnosis of psychiatric disorders, it is important to address if TBIs do indeed, increase the rate of having a new onset of a psychiatric disorder as classified by the DSM (*The Diagnostic and Statistical Manual of Mental Disorders*), specifically depressive and anxiety disorders. It becomes essential to establish a link between TBIs and novel psychiatric disorders so patients have earlier treatment post-injury thereby reducing risk of suffering long-term disabilities due to injury. Gould and Ponsford<sup>4</sup> demonstrated that the majority of the participants in their study suffered post-injury psychiatric disorders after sustaining a TBI, many for the first time. Researchers also showed that a 1-year psychosocial outcome is significantly and independently related to psychiatric disorders present pre-injury, early post-injury, and at time of study analyses.<sup>4</sup> In a birth cohort study<sup>5</sup> in Finland in which a general population cohort was followed prospectively for 30 years, researchers demonstrated that patients who sustained a TBI

in childhood or adolescence had an increased risk of developing mental disorders two-fold and TBI was closely related to developing a later mental disorder with coexisting criminality in male cohort members. This review looks to establish a relationship between patients in the general population who have sustained a TBI which results in a novel psychiatric disorder, mainly depression and/or anxiety, at a minimum of one year post-injury.

## **METHODS**

An exhaustive search of medical literature was conducted using Medline-Ovid, CINAHL, Web of Science, MedLine-PubMed, and Up to Date using the key words: brain injuries, mental disorders, diagnostic and statistical manual of mental disorders, and DSM. The search was refined using only those articles published in English language and studies performed with human patients. Eligible studies also needed to be conducted on participants who 1) were between the ages of 16 and 80, 2) had sustained a traumatic brain injury (mild, moderate, or severe based on GCS (Table 1)<sup>6</sup> at time of injury 3) were members of the general population (soldiers sustaining head injuries during war-time situations are excluded), 4) had a minimum of one year follow-up from time of TBI, and 5) were diagnosed with psychiatric disorders using DSM IV criteria. Furthermore, the reference lists and bibliographies of the articles were further searched looking for other relevant studies. Relevant articles were assessed for quality using the Grading of Recommendations, Assessment, Development and Evaluation (GRADE)<sup>7</sup> (see Table 2).

## RESULTS

The initial search resulted in 166 articles which were narrowed down to seven applicable studies<sup>8-14</sup> based on inclusion criteria. Of these seven studies, five were prospective<sup>8-12</sup> and two were retrospective<sup>13-14</sup> (Table 3).

### **Kopenen et al (2011)**

This prospective observational study<sup>8</sup> was performed on 45 consecutive patients who had presented to the emergency unit of Turku University Hospital in Turku, Finland to be treated because of sustaining a TBI. The authors evaluated rates of psychiatric disorders before sustaining a TBI as compared to after sustaining a TBI. Follow-up from time of injury was approximately one year. Of the 45 original patients, 38 were evaluated at 12 months after the injury. Inclusion criteria for participation in the study included acute brain trauma defined as less than 3 days that included: 1) eye-witnessed LOC (loss of consciousness) for minimum of one minute, 2) post-traumatic amnesia for minimum of at least 30 minutes, 3) neurological symptoms or signs of brain injury during first three days (excluding headache and nausea), 4) neuroradiological findings indicative of TBI. Furthermore, participants had to be between the ages of 16-70 years old. Any patient with any other central nervous disease was also excluded. No control group was used. DSM-IV diagnostics were used to assess axis I psychiatric disorders with the aid of the SCAN (Schedules for Clinical Assessment in Neuropsychiatry). The interviews of the patients were performed by a research psychiatrist. . The overall rate of depressive disorders at the 12-month follow-up was 21.1% (95% CI=9.6-37.3) which included those with an onset before or after TBI. This study illustrated a novel depressive disorder in five patients (13.2%; 95%=4.4-28.1) (see Table 2). Thus the authors concluded that depression was the most prevalent mental disorder among participants post TBI.<sup>8</sup>

## **Bryant et al**

This is a prospective cohort study<sup>9</sup> which looked at trauma injured patients to evaluate prevalence of axis I psychiatric disorders, levels of quality of life, and mental health services at 3 and 12 months post-injury. Researchers also wanted to address what role a mild TBI may have in a patient developing a psychiatric disorder. The study took place across four trauma hospitals across three states of Australia. The inclusion criteria were hospital admission of at least 24 hours and patients between the ages of 16 and 70 with ability to understand English proficiently. Patients with moderate to severe brain injury were excluded as well as those patients whom were non-Australian visitors, currently suicidal or psychotic, or under police guard at time of admission. Moderate to severe brain injury was defined as follows: LOC of greater than 30 minutes or a GCS (Glasgow Coma Scale) of less than 13 upon arrival to the hospital. Mild TBI was defined as meeting ICD-9 requirement of documented injury to the head, LOC of less than 30 minutes, and no focal neurological deficit or intracranial complications. Of the initial 1084 patients who met inclusion criteria 437 had sustained a mild TBI, mainly from a motor vehicle accident (75.9% of mild TBI patients). At twelve months post-injury, 116 patients had been lost to follow-up but 249 of the original 437 patients had either a depressive or anxiety disorder. Of these 249 patients 27 had a novel depressive disorder and 113 had a novel anxiety disorder (See Table 3). One year after sustaining a traumatic injury (including mild TBI or not), the authors demonstrated that there was a 23% incidence of the development of a new psychiatric disorder that the patient had never had before. The two most common new disorders were depression and generalized anxiety disorder. Researchers also found a direct correlation in the fact that “patients who had sustained a mild TBI were twice as likely to develop PTSD, panic disorder,

agoraphobia, or social phobia as those patients without a TBI.<sup>9</sup>” The authors concluded that mild TBIs play a significant role in the development of novel anxiety and depression.<sup>9</sup>

### **Gould et al**

In this prospective study<sup>10</sup> researchers attempted to evaluate the frequency of psychiatric disorders occurring pre- and post-injury with a focus on the course of post-injury disorders. The study consisted of 102 participants who had predominantly sustained a moderate to severe TBI and they were reassessed at 3, 6, and 12 months post injury. All patients’ disorders were assessed using the SCID (Structured Clinical Interview) for DSM-IV disorders. The study was done in Australia and patients were “recruited from consecutive TBI admissions to a rehabilitation hospital that treats 30-50% of all head injuries in the state.<sup>10</sup>” Inclusion criteria was as follows: complicated mild TBI and presence of intracranial abnormalities on neuroimaging, moderate or severe TBI; age at time of injury between 16-80 years old, no previous TBI or other neurological disorder; residence in Australia post-discharge; and proficiency in the ability to complete interviews according to the neuropsychologist in English. The majority of the TBIs sustained were from MVAs (motor vehicle accidents) (64.4%). Over half the participants met criteria for one or more pre-injury lifetime psychiatric disorder. During first year post-injury, almost 61% of participants were diagnosed with one or more psychiatric disorders. Researchers found that of the 48 participants without a pre-injury psychiatric disorder, 22 (45.8%) developed a novel post-injury psychiatric disorder. Looking specifically at depression and anxiety disorders, 39 (38.2%) of the original 102 patients had a pre-existing diagnosis of depression and/or anxiety disorders and at one year 77 (75.5%) of patients had a diagnosis of depression and/or anxiety disorders (see Table 2). There were 15 novel cases of depressive disorders post-injury at one year and 23 novel cases of anxiety disorders post-injury 1 year (see Table 3).<sup>10</sup> Researchers concluded that

psychiatric disorders appear to be common in patients with TBIs, both prior to, and in the first year post-injury. They also found that the rates of novel psychiatric disorders following injury were substantial.<sup>10</sup>

### **Jorge et al**

This is a prospective, case-controlled, surveillance study<sup>11</sup> which looked at episodes of MDD (major depressive disorder) in patients in the first year after sustaining a TBI. The setting was the University of Iowa Hospitals and Clinics and the Iowa Methodist Medical Center. Psychiatric diagnoses were made using clinical interview and DSM-IV criteria. A total of 91 patients made up the study group and 27 patients who had sustained multiple traumas but showed no evidence of CNS (central nervous system) injury made up the control group. Included were patients who presented to either hospital with a closed head injury (CHI). Excluded were patients with a penetrating head wound, patients with radiologic or physical findings of spinal cord injury, and those with severe comprehension deficits. Of the participants, 68 (74.7%) sustained a closed head injury due to an MVA. The severity of the CHI was determined using the 24-hour GCS scale (Table 1). Patients were followed-up for 3, 6, and 12 months post-injury. Among the patients who had sustained a TBI there were 30 patients who developed a new depressive disorder within first year post-injury and among these 30 patients, 23 also presented with a co-morbid anxiety disorder (see Table 3). The authors also showed that when compared with non-depressed patients, patients with TBI who developed major depression had a significantly higher frequency of personal mood disorders ( $P=0.01$ ) and personal history of anxiety disorders ( $P=0.05$ ). Researchers concluded the frequency of MDD in patients who had sustained a TBI was higher as compared to other patients who had sustained other traumatic injuries but without involvement of the CNS (central nervous system).<sup>11</sup>



**Diaz et al**

This is a prospective study<sup>12</sup> that was conducted at the Governador Celso Ramos Hospital. The focus of this study was to look at psychiatric manifestations in patients 18 months after hospitalization in which the patient suffered a severe TBI. Psychiatric manifestations were addressed using the SCID. Other characteristics looked at were demographics, clinical, radiological, neurosurgical, laboratory, and psychosocial. The study group consisted of 33 patients who had sustained a severe TBI (GCS equal to or less than 8 within first 48 h of hospital admission), over the age of 18 at time of injury, and a resident of the Florianopolis metropolitan area. Patients who had sustained a GSW (gunshot wound) were excluded from the study. The study shows a significant increase in rates of MDD ( $p=0.02$ ) and generalized anxiety disorder (GAD) ( $p=0.02$ ) after TBI.<sup>12</sup> The authors illustrate that pre-injury, two patients had diagnosis of MDD and no patients demonstrated having GAD. Post-injury, nine patients demonstrated diagnosis of MDD and five demonstrated having GAD (Table 3). Researchers found that MDD and personality changes were the two most common psychiatric disorders in patients who had suffered a severe TBI.<sup>12</sup>

**Kaponen et al (2002)**

This is a retrospective 30-year follow-up study<sup>13</sup> in which 60 patients were 30 years after sustaining a TBI on average. This study looked at occurrence of axis I and axis II disorders after TBIs. Axis I disorders were diagnosed with the DSM IV with the aid of the Schedules for Clinical Assessment in Neuropsychiatry. This study took place at Turku University Central Hospital in Turku, Finland. It originally began with 210 patient who had had a TBI between 1950 and 1971.<sup>13</sup> Of the original 210 patients, 76 had died. Of the remaining, 13 did not meet inclusion criteria which were as follows: head trauma severe enough to cause neurological

symptoms lasting at least one week; and at least one of the following: LOC of at least one minute, posttraumatic amnesia for at least 30 minutes, neurological symptoms (excluding HA (headache) and nausea) during first three days following injury, or neuroradiological findings suggesting brain injury. Exclusion criteria were neurological illness before the TBI, clinical symptoms of non-traumatic neurological illness that developed after the TBI (excluding dementia), insufficient cooperation, or unavailability of medical records. After accounting for patients not meeting certain criteria as well as losses to follow-up the total number of patients in this study was 60. Looking specifically at MDD and GAD, there were no incidences among the 60 patients interviewed pre-injury. Post-injury, 16 (26.7%) patients were diagnosed with MDD (6 within the first year) and one patient (1.7%) was diagnosed with GAD. The authors concluded that TBIs not only temporarily disturb brain function, but they may cause decades-long damage, leaving patients more vulnerable to suffering future psychiatric disorders.<sup>13</sup>

### **Whelan-Goodinson et al**

This is a retrospective study<sup>14</sup> that evaluates the nature and frequency of Axis I psychiatric disorders pre- and post-TBI. In diagnosing psychiatric disorders, the SCID for DSM-IV disorders (SCID-I) was used. The study took place in a hospital setting in Australia. One hundred patients who had sustained a mild to severe TBI participated in the study. To be eligible for the study patients had to be a minimum age of 17 and no older than 75, be sufficient enough in English to complete the interviews, and have no history of previous TBIs or neurological disorders (including stroke, epilepsy, brain tumor, or neurodegenerative disease. Patients were assessed anywhere from 6 months to 5.5 years after their TBI. Of the 100 participants, 17 patients were given pre-injury diagnosis of depression and 13 were given a pre-injury diagnosis of any anxiety order. Post-injury, 46 patients were given a diagnosis of depression and 38

patients were given a diagnosis of any anxiety disorder. There was a total number of 33 novel disorders of depression and 28 novel disorders of any anxiety disorder. Post-injury depression and anxiety were the two most common diagnoses in the patient population. Of any type of anxiety disorder GAD was the most common type with it being prevalent in 17% of the patient population post-injury. This study showed that the two most common novel psychiatric disorders in patients suffering from a TBI were depression and anxiety disorders.<sup>14</sup>

## **DISCUSSION**

Traumatic brain injuries can lead to the onset of new psychiatric disorders. Of these psychiatric disorders depressive disorders appear to be the most prevalent (Table 3).<sup>8-14</sup> Looking over the recent literature,<sup>8-14</sup> we see an increase in the number of novel disorders of depressive symptoms within the first year after sustaining a TBI.<sup>8-14</sup> Many times this coincides with an anxiety disorder.<sup>11</sup> Although some studies have shown that people in the general population who have a pre-existing psychiatric disorder as defined by the DSM IV<sup>8,10,12,14</sup> may be at a higher risk of sustaining a TBI whether it be due to alcoholism, depression, or even axis II disorders. In the studies<sup>8-14</sup> reviewed there is extensive research at this point that links the new onset of psychiatric disorders, specifically depression and anxiety, with TBIs. Unfortunately though in a review of the literature there are also many limitations found in the studies.

### **Limitations**

The most frequent limitation encountered was a small sample size.<sup>8-14</sup> In doing a review that is focused on the general population this decreases the overall validity and reliability in applying the results. Researchers also noted that because of such a small sample size the severity of TBIs and the impact this may have on psychiatric disorders could not be thoroughly studied.<sup>8</sup> Other studies reviewed were limited by the fact that there was no control group in place (Table

3).<sup>8-12</sup> In not being able to compare results to a control group it becomes increasingly difficult to apply the results to the general population as a whole. Another limitation encountered was that the sample size was made mainly young males who had sustained a TBI.<sup>9-11</sup> Once again, due to small sample sizes and studies which use a group made up of one predominantly type of person (which in this case was young males) it becomes difficult to apply the results to a diverse, general population.<sup>9-11</sup> Lastly, two of the studies used a retrospective design (Table 3), which relies on the patient to retrospectively recall any mental disorders or other possible health issues, via surveys and clinical interviews with psychiatrists, they may have had before sustaining a TBI.<sup>13-14</sup> Many times the patient is an unreliable historian which may decrease the validity of the data collection. While there are a number of limitations in the recent literature (see Table 3) there are also some recommendations being made which will help improve future studies' validity and reliability in looking at novel psychiatric disorders as a result of a TBI.

### **Recommendations**

It is imperative in future studies to look at larger sample sizes across multiple hospitals/trauma centers in beginning to relate results to the general population. It is also important that researchers try to differentiate between the severity of the TBI and novel psychiatric disorders to see if there is, indeed, any correlation.<sup>8</sup> One study<sup>9</sup> reviewed did make the recommendation that it may be possible that patients with less severe TBIs have lower rates of psychiatric disorders than those patients with moderate to severe TBIs. Studies are also needed to research if novel psychiatric disorders after a TBI are a direct result of the TBI or a result of other demographic factors. These factors may include low income, marital status, and sex of the patient as well as length of recovery after the injury. These are all important factors which, in themselves, may independently lead to disorders such as depression and anxiety.

## CONCLUSION

The literature<sup>8-14</sup> shows people who sustain a traumatic brain injury are more likely to develop a novel psychiatric disorder, with the most prevalent disorder being depression. In many cases patients will develop anxiety that may co-exist with their novel depressive disorder. Screening patients for psychiatric disorders early post-TBI is recommended in order that treatment for any new onset mental disorder is not delayed. Earlier intervention post-TBI with simple screening tools may help in the prevention of long term consequences suffered by those patients who have sustained a TBI. It has been suggested that at times, novel psychiatric disorders post-TBI, become accepted as a normal reaction to the initial trauma.<sup>12</sup> It is important to realize that people who have suffered a TBI are at higher risk of developing a novel psychiatric disorder and thus this will allow us to intervene earlier post-injury. Of the studies reviewed the literature shows a link between sustaining a TBI and the development of depression and/or anxiety. Future research which uses longitudinal, prospective studies focusing on larger population sizes, severity of TBIs, and comparing pre and post psychiatric disorders is warranted.

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## **Table 1**

From UpToDate 2013

### **Glasgow coma scale**

	Score
<i>Eye opening</i>	
Spontaneous	4
Response to verbal command	3
Response to pain	2
No eye opening	1
<i>Best verbal response</i>	
Oriented	5
Confused	4
Inappropriate words	3
Incomprehensible sounds	2
No verbal response	1
<i>Best motor response</i>	
Obeys commands	6
Localizing response to pain	5
Withdrawal response to pain	4
Flexion to pain	3
Extension to pain	2
No motor response	1

### **Total**

The GCS is scored between 3 and 15, 3 being the worst, and 15 the best. It is composed of three parameters: best eye response (E), best verbal response (V), and best motor response (M). The components of the GCS should be recorded individually; for example, E2V3M4 results in a GCS score of 9. A score of 13 or higher correlates with mild brain injury; a score of 9 to 12 correlates with moderate injury; and a score of 8 or less represents severe brain injury.

**TABLE 2** Characteristics of Reviewed Studies, GRADE profile

		Downgrade Criteria					Number of Patients		Quality	Importance
Study	Design	Limitations	Indirectness	Imprecision	Inconsistency	Publication bias likely	Sample Size	Control		
Kaponen et al (2011) <sup>a</sup>	Prospective Observational	Very Serious Limitations <sup>a,e</sup>	No serious indirectness	Moderate imprecision <sup>b</sup>	No serious inconsistencies	No bias likely	N=45	No	Very low	Important
Bryant et al <sup>9</sup>	Prospective Cohort	Some limitations <sup>a</sup>	No serious indirectness	No serious imprecision	No serious inconsistencies	No bias likely	N= 1084 (437 mild TBI)	No	Very Low	Important
Gould et al <sup>10</sup>	Prospective	Some limitations <sup>c,e</sup>	No serious indirectness	Moderate imprecision	No serious inconsistencies	No bias likely	N=102	No	Very Low	Important
Jorge et al <sup>11</sup>	Prospective, case-controlled	Very serious limitations <sup>c,d</sup>	No serious indirectness	Moderate imprecision <sup>b</sup>	No serious inconsistencies	No bias likely	N=91	N=27	Very Low	Important
Diaz et al <sup>12</sup>	Prospective	Very Serious Limitations <sup>a-c</sup>	No serious indirectness	Moderate imprecision <sup>b</sup>	No serious inconsistencies	No bias likely	N=33	No	Very low	Important
Kaponen et al (2002) <sup>13</sup>	Retrospective F/U	Very Serious Limitations <sup>a,b,e,f</sup>	No serious indirectness	Moderate imprecision <sup>b</sup>	No serious inconsistencies	Recall bias likely	N=60	No	Very low	Important
Whelen-Goodinson et al <sup>14</sup>	Retrospective Cross-Sectional	Very Serious Limitations <sup>a-c</sup>	No serious indirectness	Moderate Imprecision <sup>b</sup>	No serious inconsistencies	No bias likely	N=100	Compared results to general population	Very low	Important

<sup>a</sup> Use of only one emergency unit/hospital raises a high risk for selection bias

<sup>b</sup> Small Sample size

<sup>c</sup> Predominantly male subjects, mild TBIs not investigated

<sup>d</sup> Predominantly males in Iowa (not representative of population as a whole)

<sup>e</sup> No control group

<sup>f</sup> Study by Kaponen (2) limited by 30 year retrospective design in which patients were asked to recall certain events and previous psych disorders. Very serious limitation

**Table 3: Summary of Findings**

<i>Study</i>	<i>Sample Size</i>	<i># Loss to Follow-Up or Excluded at 12 months</i>	<i># Cases w/Pre-TBI Depression and/or Anxiety Disorder</i>	<i># Cases w/Post-TBI Depression and/or Anxiety Disorder (min of 1 year)</i>	<i>Incidence Novel Depressive disorders Post-TBI (min 1 year)</i>	<i>Incidence Novel Anxiety Disorder Post-TBI (min 1 year)</i>
Kaponen et al (2011) <sup>a</sup>	N=45	N= 7	N=4 (10.5%)	N=8 (21.1%)	N=5 (13.2%)	Not addressed
Bryant et al <sup>9</sup>	N=1084 (437 with mild TBI)	N=116 (of original 437)	Not addressed	N= 249 (77.5%)	N=27 (7.1%)	N= 113(29.9%) <sup>a</sup>
Gould et al <sup>10</sup>	N=102	N=0	N=39 (38.2%)	N=77 (75.5%)	N=15 (14.7%) <sup>f</sup>	N=23 (22.5%)
Jorge et al <sup>11</sup>	N=91	N=17	Not documented <sup>g</sup>	N=47 (51.6%)	N=30 (33%) <sup>b,c</sup>	Coincided with depression in 23 patients
Diaz et al <sup>12</sup>	N=33	N=0	N=3 (MDD=2, GAD=0) <sup>d</sup>	N=14 (42.4%)	N=7 (21.2%) <sup>e</sup>	N=5 (15.1%)
Kaponen et al (2002) <sup>13</sup>	N=60	N=0	N=0	N=17(28.3%)	N=16 (26.7%)	N=1 (1.7%)
Whelen-Goodinson et al <sup>14</sup>	N=100	N=0	N=30(30%)	N=84 (84%) <sup>9</sup>	N=33(33%)	N=28(28%)

<sup>a</sup> Grouped anxiety disorders together including new onset of PTSD, social phobias, agoraphobia, OCD.

<sup>b</sup> Most of these patients exhibited comorbid anxiety disorders and aggressive behavior

<sup>c</sup> Patients most likely to have history of mood/anxiety disorders

<sup>d</sup> MDD= major depressive disorder GAD= Generalized Anxiety Disorder, one patient had history of bipolar disorder

<sup>e</sup> Recalculated rate of mood disorders including sum of MDD, dysthymic disorder, bipolar disorder, depressive disorder NOS, and mood disorder NOS

<sup>f</sup> According to table 3 of this study 36.7% of the patients with a TBI and major depression had a history of mood disorders while 20.0% had a history anxiety disorders

<sup>9</sup> Study does not clearly differentiate patients with anxiety/depression disorders but 73.5% of post-injury psych disorders were a combination of current depressive and anxiety disorders

